SHEET– Sunburn and HEat prediction in canopies for Evolving a warning Tech solution
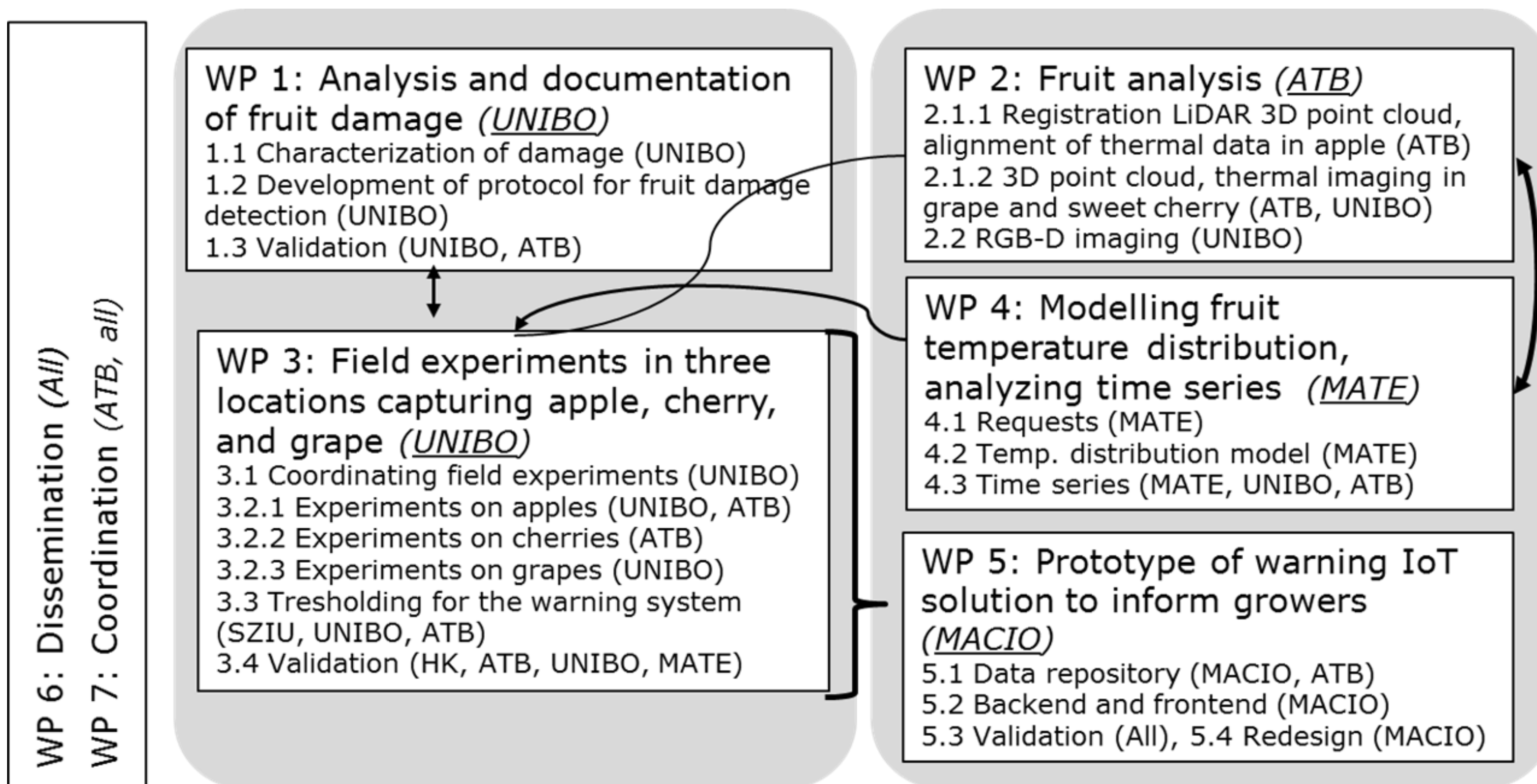
SHEET

Summary

- Excess solar radiation and elevated temperatures can produce several physiological disorders to the exposed surface including sunburn, compromising fruit quality, storability and enhancing food waste.

- Time series analysis of fruit skin temperature can be used as a reliable indicator to identify types of sunburn symptoms.

- 3D sensing methods, thermal imaging, as well as a weather station and microclimate sensors, are employed to provide the necessary high spatio-temporal resolution of data considering the canopy and particularly fruit surfaces.
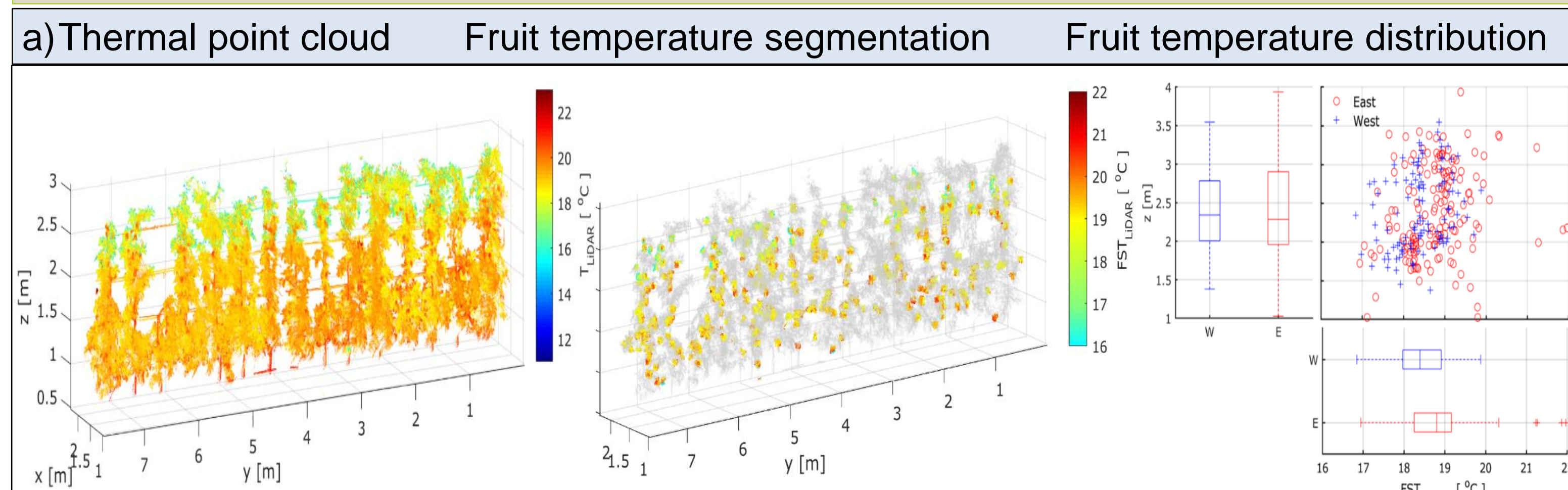
Main objective

Developing a temperature distribution model, based on a thermodynamic approach, and an artificial neural network model, to link the temperature distribution with the fruit damage. The climate and output data will be provided to the growers with a free mobile App.
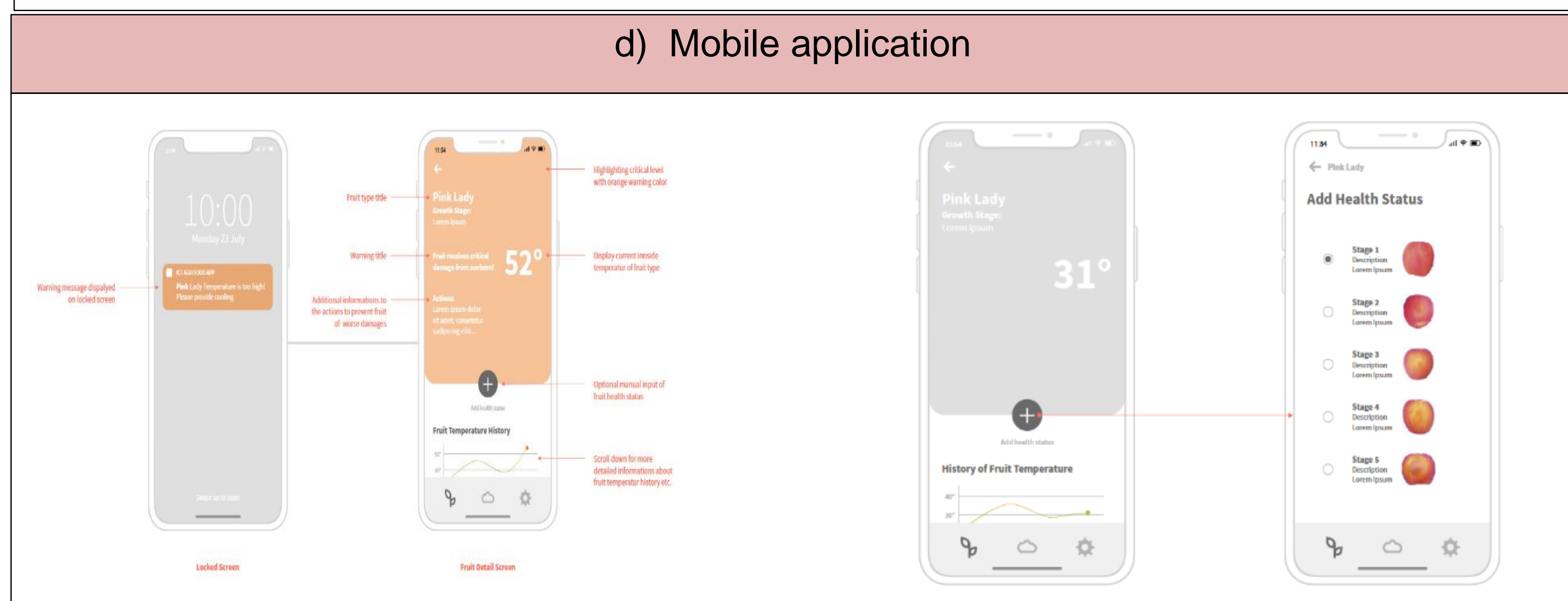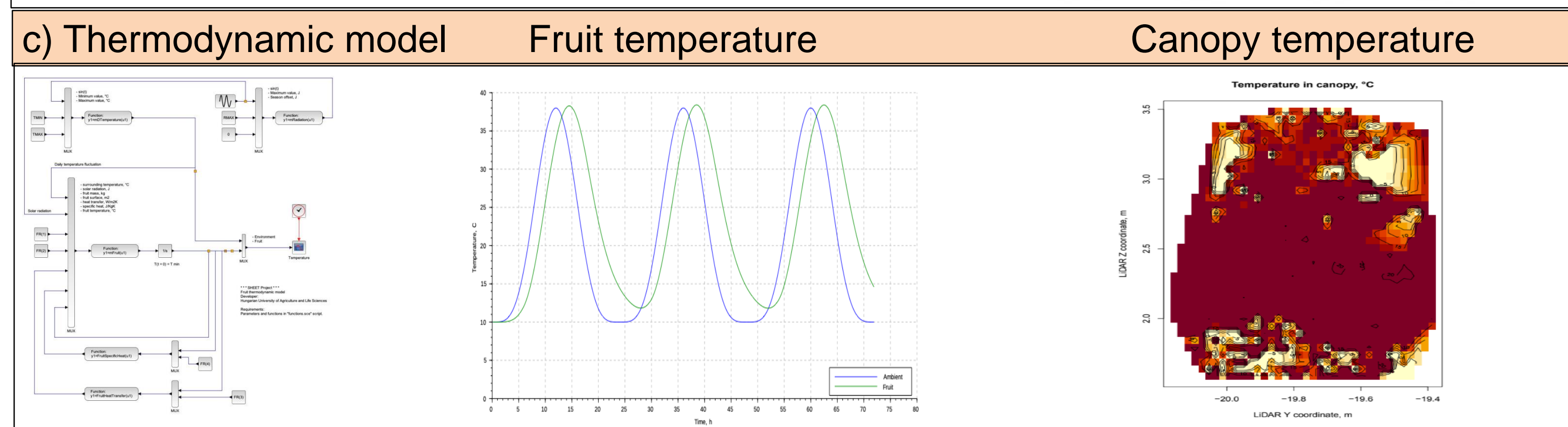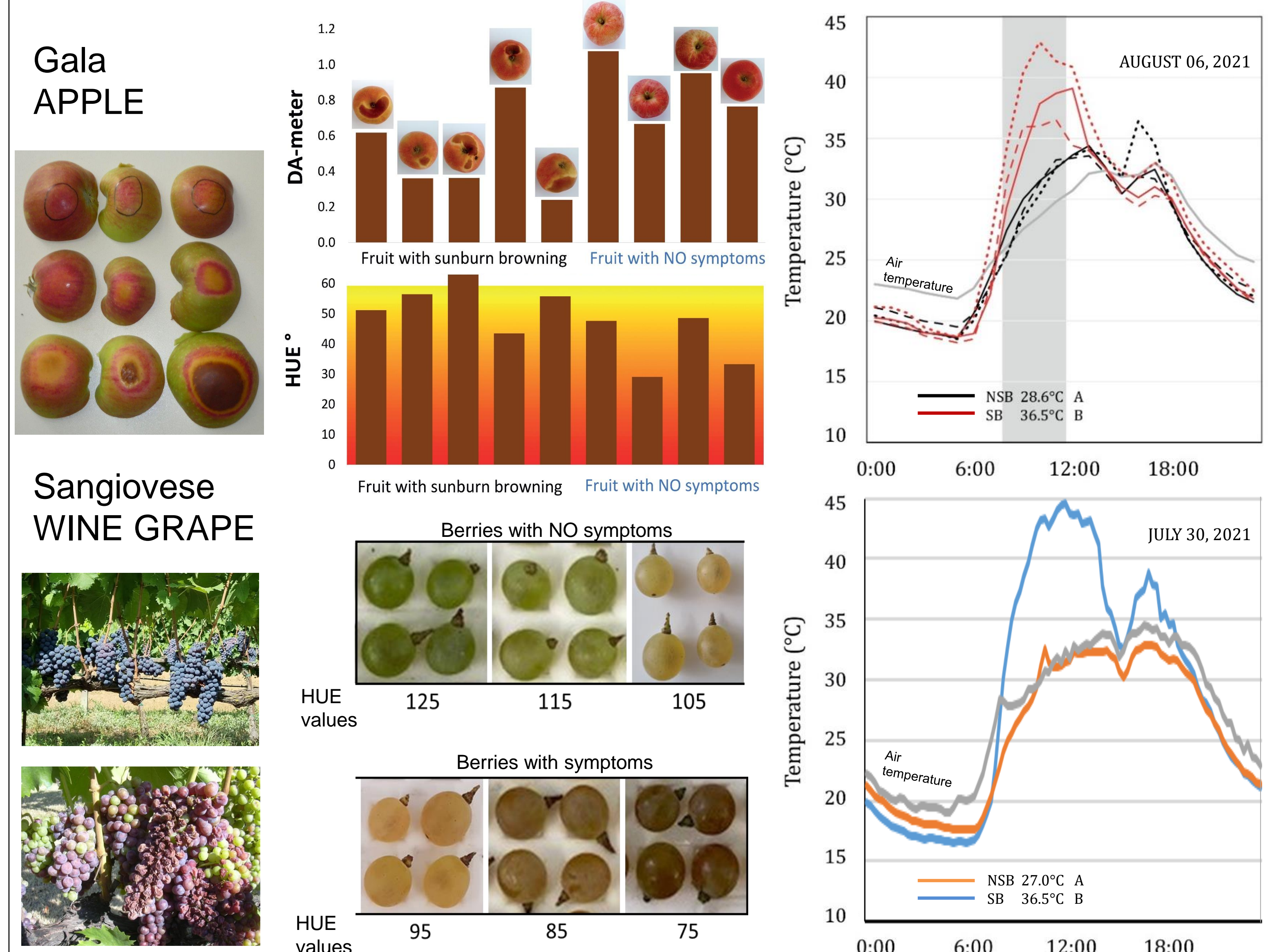
WP 6: Dissemination (All)
WP 7: Coordination (ATB, all)

WP 1: Analysis and documentation of fruit damage (UNIBO)
1.1 Characterization of damage (UNIBO)
1.2 Development of protocol for fruit damage detection (UNIBO)
1.3 Validation (UNIBO, ATB)

WP 2: Fruit analysis (ATB)
2.1.1 Registration LiDAR 3D point cloud, alignment of thermal data in apple (ATB)
2.1.2 3D point cloud, thermal imaging in grape and sweet cherry (ATB, UNIBO)
2.2 RGB-D imaging (UNIBO)

WP 3: Field experiments in three locations capturing apple, cherry, and grape (UNIBO)
3.1 Coordinating field experiments (UNIBO)
3.2.1 Experiments on apples (UNIBO, ATB)
3.2.2 Experiments on cherries (ATB)
3.2.3 Experiments on grapes (UNIBO)
3.3 Tresholding for the warning system (SZIU, UNIBO, ATB)
3.4 Validation (HK, ATB, UNIBO, MATE)

WP 4: Modelling fruit temperature distribution, analyzing time series (MATE)
4.1 Requests (MATE)
4.2 Temp. distribution model (MATE)
4.3 Time series (MATE, UNIBO, ATB)

WP 5: Prototype of warning IoT solution to inform growers (MACIO)
5.1 Data repository (MACIO, ATB)
5.2 Backend and frontend (MACIO)
5.3 Validation (All), 5.4 Redesign (MACIO)

3D phenotypic systems

Preliminary results

a) Thermal point cloud   Fruit temperature segmentation   Fruit temperature distribution

b) APPLE and WINE GRAPE Sunburn Physiology – Weather data

Gala APPLE

Sangiovese WINE GRAPE

Fruit with sunburn browning   Fruit with NO symptoms

Fruit with sunburn browning   Fruit with NO symptoms

Berries with NO symptoms

HUE values   125   115   105

Berries with symptoms

HUE values   95   85   75

AUGUST 06, 2021
Air temperature
NSB 28.6°C A
SB 36.5°C B

JULY 30, 2021
Air temperature
NSB 27.0°C A
SB 36.5°C B

c) Thermodynamic model   Fruit temperature   Canopy temperature

d) Mobile application

Preliminary conclusions

– The phenotypic platform was able to detect the temperature on apple surface.

– Detected fruit surface temperature correlated strongly with the manual measurements on the East side of the tree.

– The thermodynamic model allowed to simulate fruit temperature curve for consecutive days.

Future research activities

– Compare temporal datasets from the two phenotypic systems.

– Improve the thermodynamic model, including temporal data of microclimate and training systems.

– Release a first version of the mobile app.